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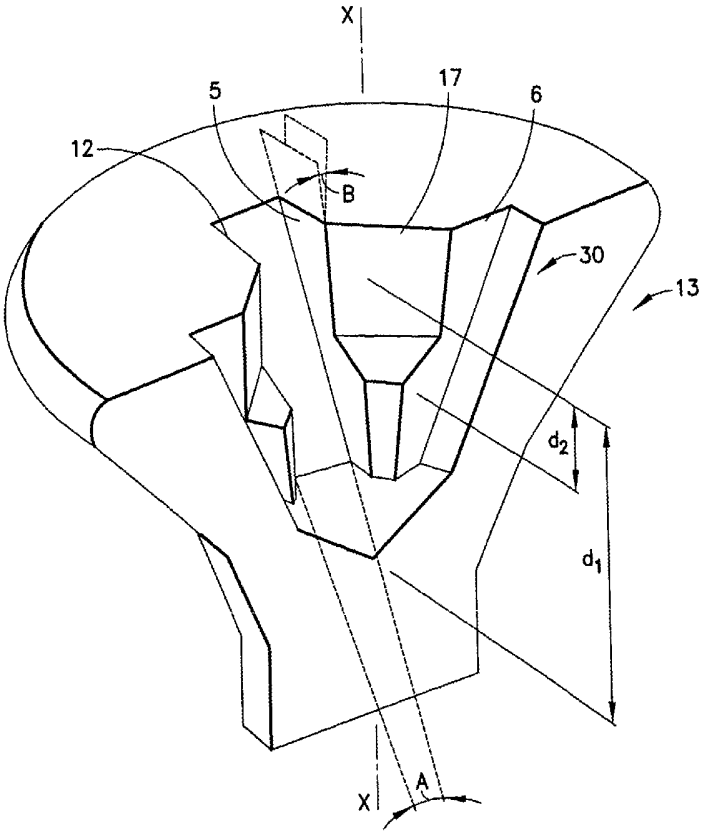
(54) Title: FASTENER HAVING RECESS USEABLE WITH MULTIPLE DRIVERS AND METHOD OF MANUFACTURE



(57) Abstract: A fastener (13) is described having a head (15) formed with a recess (30) which accommodates a square head driver, symmetrical drivers, such as PHILLIPS™ STYLE DRIVER, asymmetrical style cross head drivers, such as POZIDRIV™ style drivers, and combination square and cross drivers without compromising performance of the drivers.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

FASTENER HAVING RECESS USEABLE WITH MULTIPLE DRIVERS AND METHOD OF MANUFACTURE

Cross Reference To A Related Application

This application is a conversion of provisional application Serial No. 60/360,270, filed February 26, 2002.

Background of the Invention

There are several drivers with specialized engagement surfaces in prevalent use for industrial and domestic purposes. These drivers are, in general, only useable with screws having recesses which match the drivers. The manufacturing processes for these screws insure a proper fit with efficient transmission of torque from the driver to the screws. A common example of such drivers is the Philips head screw driver with its familiar cross wing configuration. A fastener of this type is disclosed in U.S. Patent No. 2,046,839 and the disclosure of this patent is incorporated herein by reference. Fasteners of this type are in widespread use.

Although PHILLIPS head screw are used with great success, a common complaint with regard to such fasteners is that the driver tends to slip out of the recess, when the application of high torque is required. This so-called "cam out" occurs because the driving surfaces of the PHILLIPS head fastener taper at an included angle of 8°-27°. In order to overcome this inconvenience and to provide a fastener which provides a high torque capability, the driving surface was constructed more vertical as described in U.S. Patent no. 2,474,994. The disclosure of the '994 patent is also incorporated herein

by reference. Fasteners of this type are available from licensees of Phillips Screw Company and sold under the trademark POZIDRIV.

Another type of driver referred to as the "square drive" is designed to fit the Robertson square drive recess and is also in common use.

It is a purpose of this invention to provide a recess which effectively accommodates any of the above drivers and to provide an optimum driver adapted especially for use with this unique recess.

To better understand the invention of this application, it is beneficial to consider the basic process of manufacturing the drivers and mating fastener heads of the above referenced fasteners. It is key in the process to construct, to close tolerances, a die which is used to cold form drivers and punches by pressing. Punches are tools used to cold form the recess in the fastener head. Since each element is used progressively to obtain the final product, it should be realized that errors become compounded throughout the process.

A master tool having all of the attributes of the punch and driver is constructed as a first step. This tool is generally machined from an appropriate metal blank using an abrasive wheel. In the case of the PHILLIPS cross head tool, this requires four passes, between which the tool is rotated 90°. The tool is held at angle to the path of the wheel to construct grooves in the master tool that become more shallow as the machining stroke progresses from the tip to the shank of the master tool blank. The die is formed using the master tool by

hobbing or pressing the master tool into die stock. This may take several strokes to obtain the fully formed die. The die is then used to cold form a punch which is in turn used as the tool to cold form a recess in the head of the fastener.

Drivers are constructed in a manner similar to the punches and are identical in shape to the punch and master tool.

The manufacture of the PHILLIPS cross head master is relatively straight forward because the driving surfaces are symmetrical. This is not the case with respect to the manufacture of the vertical driving surfaces of the modified cross head fastener of the '994 patent. In this instance, it has been found that to obtain an accurate relationship with respect to the driving surfaces of a wing of the recess and that of the driver, it is necessary to construct the forward driving face vertical and the reverse driving face at a small taper. The planes of these tapered surfaces, if extended, would intersect at an included angle of 2.5° or looking at it another way the reverse driving surface is tapered at an angle of 2.5° to the forward driving surface. This provides the needed relief from cam out in the forward direction where it is more problematic.

To accomplish this according to the above process, the master tool blank is machined using eight strokes, between which, the blank is rotated and the angle of the blank with respect to the wheel path is also adjusted. This involves the machining of compound angles, i.e., angles which are dependent on other angles and is extremely complex and difficult to control to the

required tolerances. The machining of the master tools for such asymmetrical cross head screws is an acknowledged challenge.

Although attempts have been made to combine the Robertson square drive with a PHILLIPS type drive, see U.S. Patent Nos. 5,358,368 and 5,020,954, these have not been well received and do not accommodate the use of an asymmetrical driver. U.S. Patent No. 2,082,748 discloses a fastener that combines a Robertson recess with a PHILLIPS type recess and a slot type recess. It appears that such attempts have generally compromised the advantage of one type of recess or the other.

It is a purpose of this invention to provide a recess for a fastener which will accommodate a square driver, and symmetrical and asymmetrical cross bladed type drivers. This recess therefore, will accommodate the wide variety of fastener drivers currently in use. It is a purpose of this invention to provide such a recess while avoiding the complex manufacturing requirements of the asymmetrical type cross head and without compromising the beneficial features of the common driver configurations. It is also a purpose to provide a unique driver to take and advantage of all of the unique features of the new recess.

Summary of the Invention

A cross type recess is constructed on the head of a threaded fastener having its driving faces tapered symmetrically. The taper is designed to provide an included angle between the driving surfaces equal to the standard included angle of an asymmetrical cross head recess. A square drive recess is incorporated into the

geometry of the cross type recess at the outer portion of the recess, thereby forming an overall recess configuration that will accommodate the standard drivers associated with the square drive recess, the symmetrical cross head drivers, and the asymmetrical cross head drivers. In addition such fasteners can be used which is constructed with the full geometric form of the recess. This allows fasteners, formed with the recess of this invention, to be driven with the majority of drivers prevalent in the current market.

The cross head recess of this invention is formed from a punch which is in turn formed from a die which is in turn formed by a machined master tool. The master tool is machined with a grinding wheel using four passes to obtain symmetrically shaped grooves defined by driving surfaces tapered at ½ of the included angle of the standard asymmetrical cross type recess.

The cross portion of the recess extends to the full depth of the recess while the square portion of the recess extends to a lesser depth. The depth of the square portion of the recess is chosen to be within the geometry of the cross recess, thereby providing a clearance for the ridges at the corners between opposite wing faces of the asymmetrical tool. Such ridges are a by product of the manufacturing process of asymmetrical type drivers and are one factor which hinders the interchangeable use of the cross type drivers. Another hindering factor is the symmetrical versus asymmetrical tapering of the driving surfaces. By using a symmetrical taper as in the original cross head design, at an angle which accommodates the included angle of the asymmetrical cross head design, it has been found that each type of driver

can be used in the recess of this invention without compromising the torque transmittal characteristics of the drivers. In addition "cam out" is minimized and the manufacturing process is simplified.

In order to accommodate the multiple drivers the recess of this invention has a unique shape. Engagement with anyone of the standard drivers will provide an effective transmission of torque from the driver to the fastener utilizing the unique features of each type of driver. Nevertheless a driver especially constructed to match the recess will have further advantages over any of the individual types. Such a driver is constructed to match the master tool or punch of this invention for application specifically for engagement with the universal recess of this invention.

Description of the Drawing

The invention is described in more detail below with reference to the attached drawing in which:

Figure 1 is a perspective view of a master tool used in the formation of a recess in accordance with this invention;

Figure 2(a) is a perspective view of a tip of an asymmetrical driver;

Figure 2(b) is a perspective view of a tip of a symmetrical driver;

Figure 3 is an a top view of a fastener showing the recess according to this invention; and

Figure 4 is a cut away perspective view of the head of a fastener showing the recess according to this invention.

Description of the Preferred Embodiment

The specifications for recesses and drivers of the types referenced above and further described herein are controlled by industrial standards to provide continuity of configuration across the wide variety of applications and manufacturers. Therefore when a particular fastener is described herein, a fastener complying with such standards are intended. The Industrial Fastener Institute (IFI) promulgates such standards in particular in ASME rev. B18.6.5M, 1998. In these standards Type I refers to symmetrical cross recessed fasteners, Type Ia refers to asymmetrical cross recessed fasteners, and Type III refers to square recessed fasteners.

As shown in figure 3 and 4, the recess 30 of this invention is formed with wing shaped cross slots 1-4. These slots are defined by opposing walls 5-12 which provide the driving surfaces of the fastener 13. The recess 30 has an opening at the top surface 14 of fastener head 15 and extends downward, a depth d_1, to its bottom 16. At the top surface 15, the opening of the recess 30 has a combination square and cross shaped opening. Square driving surfaces 17-20 are formed to an intermediate depth d_2 which is less than the full depth d_1 of the recess 30.

The opposing walls 5 and 12 form the slot 1 and are constructed at an angle to the vertical, i.e. to the longitudinal axis x shown in figure 4, in which the walls

are converging from top to bottom. The angle of convergence A is also referred to as the included angle and is equal to the included angle of the asymmetrical cross head fastener as set out in the applicable ASME standard. This angle is obtained by tapering the walls 5-12 symmetrically at angles B and C, as shown in figures 1 and 4. According to the standard, this would mean that angles B and C are 1.25°, thereby forming a converging angle A of 2.5°. The opposing walls 6 and 7, 8 and 9, and 10 and 11 are similarly constructed to provide a cross head recess 30 with symmetrical slots having opposing driving surfaces converging at 2.5°.

The outer portion of the recess 30 is shaped to accommodate a square driver according to the applicable standard. Substantially vertical walls 17-20 intersect at right angles as shown in phantom in figure 3. Walls 17-20 include transition shoulders 21-24 which taper downward to form the bottom seat of the square drive portion of the recess 30 of fastener 15. The depth d_2 of the square drive portion is selected to position the square drive driving surfaces, i.e. walls 17-20, within the geometry of the cross drive portion of recess 30. This will provide a clearance for the asymmetrical driver 80, as described below.

To manufacture the recess 30, a master punch 40 is constructed of tool grade steel, as shown in figure 1. The purpose of the master punch 40 is to form a die (not shown) having a female die cavity in the form of the recess 30. The die is used to form punches for cold forming the recess 30 into the heads of fasteners and to form drivers optimally configured to engage the recess 30. Master punch 40 is machined having grooves 41 which

are defined by symmetrically tapered walls 42-49. The walls 42-49 also define blades 50-53 which converge towards tool axis y, from shank to tip. The blades 50-53 match the cross shape of the recess 30 and extend the full length l_1 of the active surface of master punch 40. Adjacent walls, such as 42 and 43 of blade 50, converge at an included angle A with each wall forming an angle to the vertical, B and C of ½ of included angle A. For the purpose of this description vertical refers to a plane parallel to axis y.

To form the square drive portion of recess 30, the master punch 40 is machined with intermediate shoulders 54-57, 54 and 55 being shown in figure 1 (56 and 57 not shown), shoulders 54-57 taper towards axis y. The shoulders extend to axially parallel walls 60-63 having a length l_2 (62 and 63 not shown). These shoulders and walls match the shape of the square drive portion of recess 30.

In operation the square driver fits into the square portion of the recess 30 in a normal fashion for effective transmission of torque to the screw. A tip of a standard PHILLIPS style cross driver 100 is shown in figure 2(b). The driver 100 is constructed with blades 101-104 defined by driving surfaces 105-112. The driving surfaces converge symmetrically towards its tip at included angles of between 8°-27°. The driver 100 will also fit easily into the recess 30, but its driving surfaces will engage primarily at the top of the recess. This is an advantage as this provides an increased leverage for the transmission of torque.

A tip of an asymmetrical driver 80, which includes those for use with fasteners sold under the trademark POZIDRIV,

is shown in figure 2(a). The driver 80 is constructed with blades 81-84 defined by driving surfaces 85-92. The driving surfaces converge asymmetrically towards its tip at included angles of 2.5°. Driver 80 includes ridges 93-96 at the corners between opposite driving surfaces 85-92 of the asymmetrical tool. The ridges 93-96 are a by-product of the manufacturing process of asymmetrical type drivers and are one factor which hinders the interchangeable use of the cross type drivers. Because of the clearance formed by the depth of the square head portion of the recess 30, an asymmetrical driver, such as driver 80, also fits snuggly into the recess 30 with a slight clearance at its non-driving side, but an effective engagement over the face of the driving surface. Because of the small angle of taper, i.e. 1.25°, "cam out" is minimized with the symmetrical driver. Fastener heads which employ the recess of this invention, therefore, accommodate all of the prevailing drivers in a manner that maintains the advantages of each without compromising performance.

Although it is intended that the fasteners utilizing the recess 30 will be used with the existing drivers constructed in accordance with industry standards, it is understood that it would be useful to have a new driver formed to fully engage the unique configuration of the surfaces of recess 30. A driver of this type is constructed having the shape of the master tool 40 while incorporating standard clearance tolerances to facilitate insertion and release of the new driver into and from the recess 30. All of the surfaces of a new driver constructed to optimize the use of the recess of this invention are shown in figure 1 and further description is unnecessary.

CLAIMS

I claim:

1. A fastener having a recess constructed in the head thereof for engagement with a driver, said recess comprising:

a first portion constructed to receive a driver in torque transmitting engagement, wherein said driver is one of a group constructed in accordance with the industry standard for type I cross recessed fasteners or for type Ia cross recessed fasteners; and

a second portion constructed to receive a driver in torque transmitting engagement, wherein said driver is constructed in accordance with the industry standard for type III square recessed fasteners.

2. A fastener having a recess constructed in the head thereof for engagement with a driver, as described in claim 1, wherein said first portion is constructed having cross slots formed by opposing walls which comprise the driving surfaces of said fastener, wherein adjacent opposing walls symmetrically converge from said top to said bottom to form an included angle according to the standard for type Ia cross recess fasteners.

3. A fastener having a recess constructed in the head thereof for engagement with a driver, as described in claim 2, wherein said included angle is 2.5 degrees.

4. A fastener having a recess constructed in the head thereof for engagement with a driver, as described in

claim 2, wherein said adjacent opposing walls are each inclined at an angle of 1.25 degrees to the vertical to cause said convergence.

5. A fastener having a recess constructed in the head thereof for engagement with a driver, as described in claim 1, wherein said first recess has an overall geometry and is formed to a first depth and said second recess is formed to a second depth, said second depth being less than said first depth, thereby forming said second recess within said geometry of said first recess.

6. A fastener having a recess constructed in the head thereof and extending a first distance from a top and to a bottom for engagement with a driver, said recess comprising:

a cross slotted portion, having an overall cross slot geometry, and extending said first distance from said top to said bottom of said recess, said slots being formed by opposing walls, wherein said opposing walls converge symmetrically, from said top to said bottom, at an included angle according to the standard for type Ia fasteners.

7. A fastener having a recess constructed in the head thereof and extending a first distance from a top and to a bottom for engagement with a driver, said recess, as described in claim 6, wherein said included angle is 2.5 degrees.

8. A fastener having a recess constructed in the head thereof and extending a first distance from a top and to a bottom for engagement with a driver, said recess, as

described in claim 6, wherein said adjacent opposing walls are each inclined at an angle of 1.25 degrees to the vertical to cause said convergence.

9. A fastener having a recess constructed in the head thereof and extending a first distance from a top and to a bottom for engagement with a driver, said recess as described in claim 6, further comprising:

a square portion, having an overall square geometry, extending a second distance, that is less than said first distance, wherein said overall square geometry is within said overall cross slot geometry.

10. A method of forming a recess in the head of a fastener comprising the steps of:

forming a cross slotted recess portion into said fastener head extending a first depth from a top and a bottom, and having an overall cross slot geometry, said slots being formed by opposing walls, wherein said opposing walls converge symmetrically, from said top to said bottom, at an included angle according to the standard for type Ia fasteners.

11. A method of forming a recess in the head of a fastener, as described in claim 10, wherein said included angle is 2.5 degrees.

12. A method of forming a recess in the head of a fastener, as described in claim 10, wherein said opposing walls are each inclined at an angle of 1.25 degrees to the vertical to cause said convergence.

13. A method of forming a recess in the head of a fastener, as described in claim 10, further comprising the step of:

forming a square recess portion into said fastener head extending a second depth from said top, and having an overall square geometry, wherein said second depth is less than said first depth, whereby said overall square geometry is within said overall cross slot geometry.

14. A tool for forming a recess, said tool having a working portion extending from a shank to a tip a first distance, said working portion of said tool comprising:

a cross winged portion extending said first distance from said shank to said tip having an overall cross wing outer profile, said wings being formed by adjacent walls, wherein said adjacent walls converge, from said shank to said tip, symmetrically at an included angle according to the standard for type Ia fasteners.

15. A tool for forming a recess, said tool having a working portion extending from a shank to a tip a first distance, said working portion of said, as described in claim 14, wherein said included angle is 2.5 degrees.

16. A tool for forming a recess, said tool having a working portion extending from a shank to a tip a first distance, said working portion of said, as described in claim 14, wherein said opposing walls are each inclined at an angle of 1.25 degrees to the vertical to cause said convergence.

17. A tool for forming a recess, said tool having a working portion extending from a shank to a tip a first distance, said working portion of said tool, as described in claim 14, further comprising:

a square portion, having an overall square outer profile, extending a second distance, that is less than said first distance, wherein said overall square outer profile is within said overall cross wing outer profile.

18. A tool for forming a recess, said tool having a working portion extending from a shank to a tip a first distance, said working portion of said tool, as described in claim 14, wherein the tool is used to form a recess in the head of a fastener.

19. A tool for forming a recess, said tool having a working portion extending from a shank to a tip a first distance, said working portion of said tool, as described in claim 14, wherein the tool is used to form a cavity in die.

20. A driver for engaging a recess in the head of a fastener in torque transmitting relation having an engagement portion extending from a shank to a tip a first distance, said engagement portion of said driver comprising:

a cross winged portion extending said first distance from said shank to said tip having an overall cross wing outer profile, said wings being formed by adjacent walls, wherein said adjacent walls converge, from said shank to said tip, symmetrically at an included angle according to the standard for type Ia fasteners; and

a square portion, having an overall square outer profile, extending a second distance, that is less than said first distance, wherein said overall square outer profile is within said overall cross wing outer profile.

21. A driver for engaging a recess in the head of a fastener in torque transmitting relation having an engagement portion extending from a shank to a tip a first distance, said engagement portion of said driver, as described in claim 20, wherein said square portion is formed by four walls extending at right angles to each other and having exposed sections extending between said adjacent walls of said wings.

22. A driver for engaging a recess in the head of a fastener in torque transmitting relation having an engagement portion extending from a shank to a tip a first distance, said engagement portion of said driver, as described in claim 10 wherein said included angle is 2.5 degrees.

23. A driver for engaging a recess in the head of a fastener in torque transmitting relation having an engagement portion extending from a shank to a tip a first distance, said engagement portion of said driver, as described in claim 10, wherein said opposing walls are each inclined at an angle of 1.25 degrees to the vertical to cause said convergence.

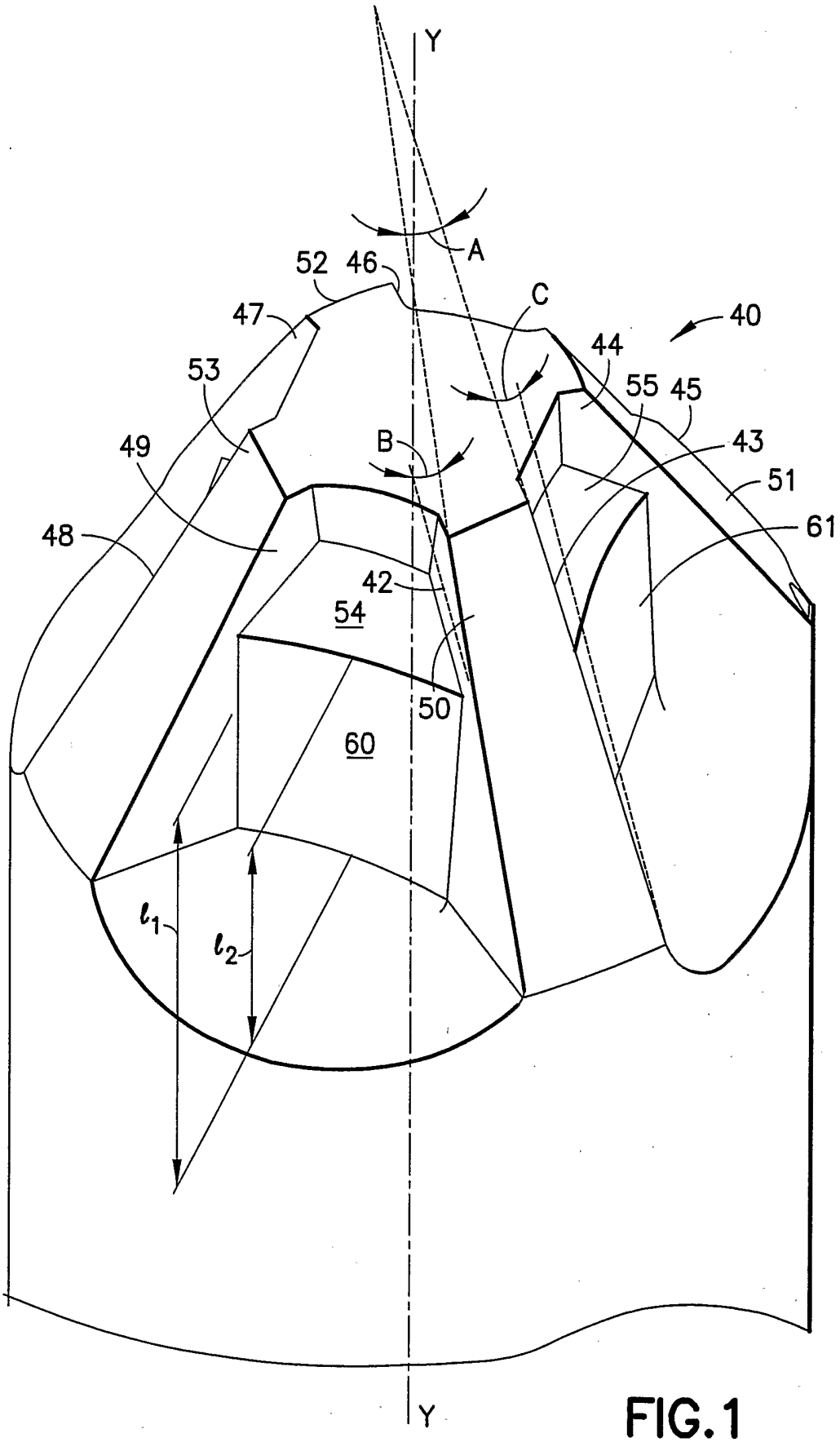

FIG.1

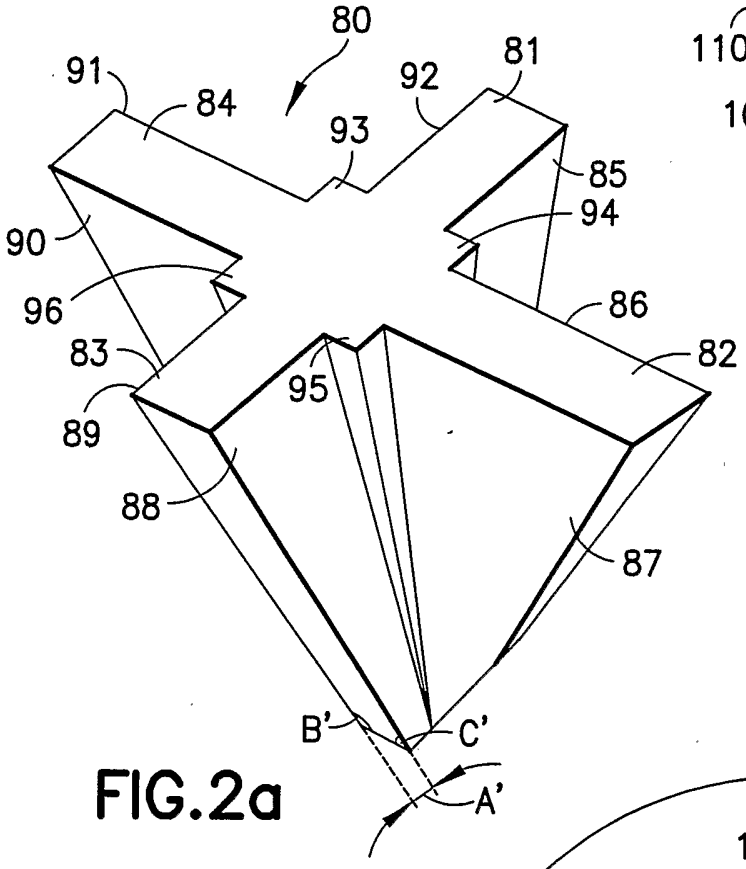

FIG.2a

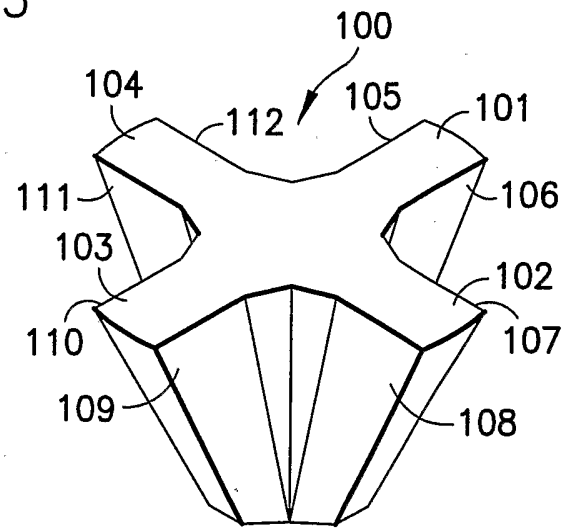

FIG.2b

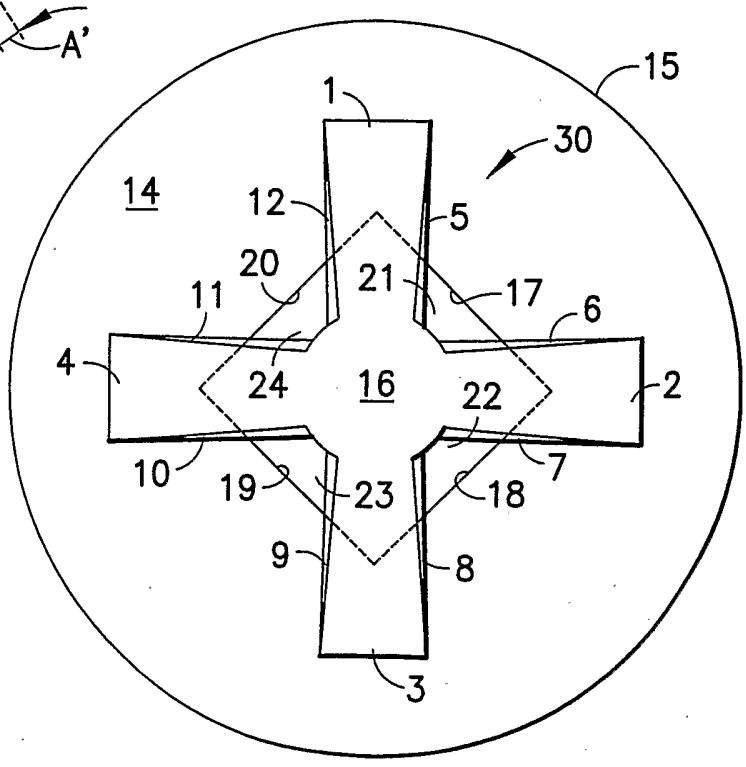

FIG.3

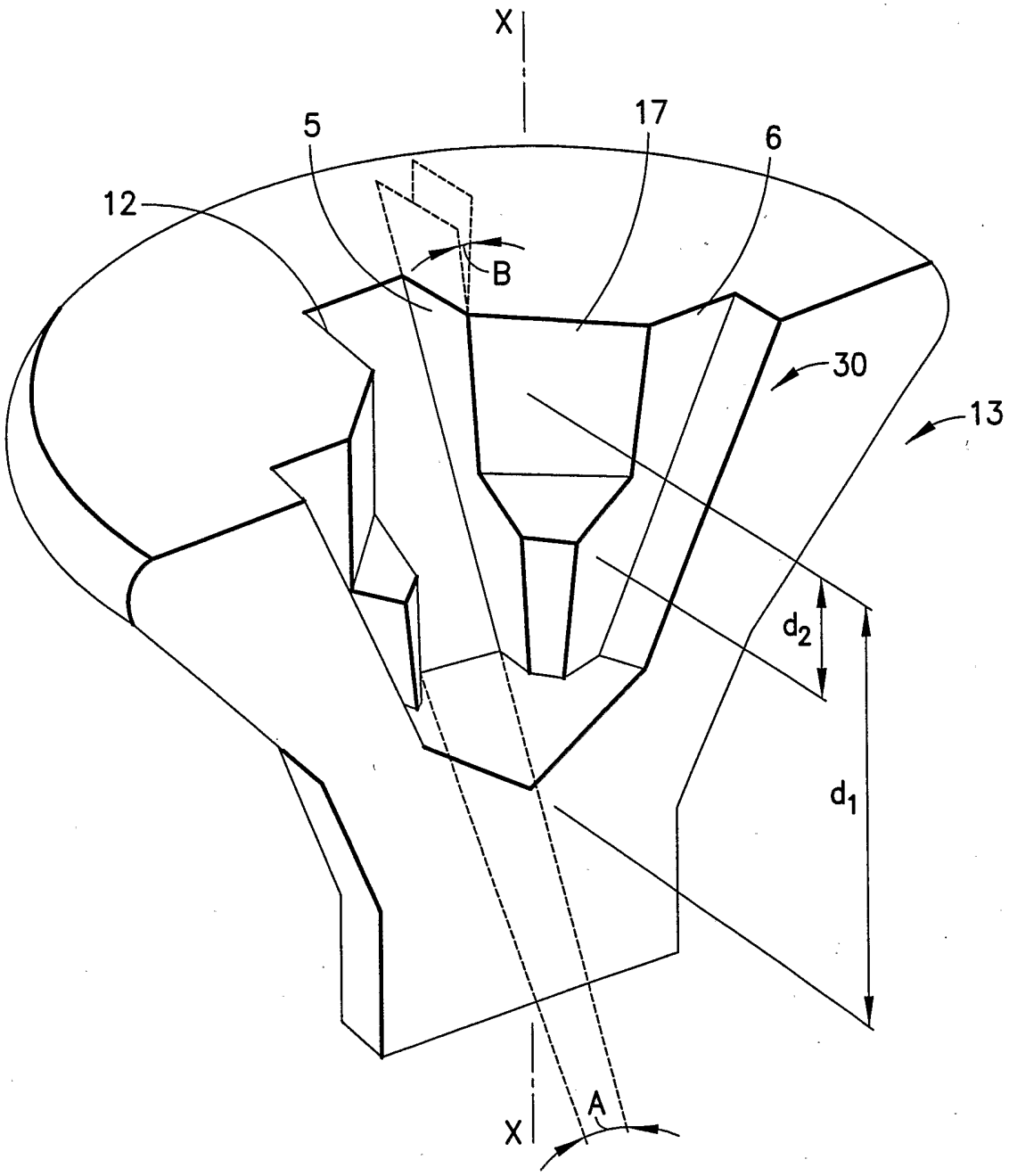

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/05594

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B25B 23/00
US CL : 81/460; 411/378; 460/8, 63
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 81/436, 460; 411/378; 460/8, 63

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,089,357 A (GILL) 16 MAY 1978, see entire document.	1-9, 20, 21 --- 10-18
Y	US 5,203,742 A (GRADY) 20 APRIL 1993, see entire document.	10-19
A	US 5,364,212 A (GILL) 15 NOVEMBER 1994, see entire document.	1-21
A	US 6,223,634 B1 (HUGHES et. al.) 01 MAY 2001, see entire document.	1-21
Y	US 6,234,914 B1 (STACY) 22 MAY 2001, see entire document.	10-19
A	US 6,314,840 B2 (BOZONNET) 13 NOVEMBER 2001, see entire document.	1-21

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 April 2003 (29.04.2003)	07 MAY 2003
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer James G. Smith Telephone No. 703-308-1148

Sheila H. Veney
Paralegal Specialist
Tech. Center 3700

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/05594

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claim Nos.: 22 and 23
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
The claims appear to depend from claim 10, which is a method of making a screw, not a screwdriver to drive the screw, thus it is unclear as to what the claimed invention is directed.

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.